Space Weather Technical Forecast

Issued on Friday 14 February 2025 at 01:19 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of Minor Geomagnetic Storm (G1) and chance of Minor Radio Blackouts (R1).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured by GOES16 reached Moderate levels, with the peak flare a M1.0 at 13/1109UTC from AR3992 in the southwest. Only slightly lower was a C9.0 flare at 13/2243 UTC from AR3990 in the southeast. There are currently ten sunspot regions on the visible disc, of which eight are numbered, and of these AR3990 and AR3992 are the largest and with the greatest potential for producing significant flares, classified as Cki/beta and Dsi/beta-gamma respectively. The remaining regions on the visible disc are either small and weak, or larger and stable.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as measured at L1 by ACE, showed a gradual increase, starting the period at Slightly Elevated levels around 450 km/s and ended at Elevated levels around 500-550 km/s, most likely due to a gradual connection to the HSS from CH14.

The solar wind density was below average throughout. The IMF was predominantly Weak, but did briefly reach Moderate levels at 9nT at 13/1830 UTC. The north-south component varied between +6 and -8nT. The phi angle was negative throughout.

The net result of the above solar wind measures was for Unsettled to Active (Kp 3 to 4) geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 persisted at Background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at High levels between 13/1500-1930 UTC, with a peak of 2426 pfu at 13/1620 UTC, and predominantly at Moderate levels for the rest of the time. The associated 24-hour fluence persisted below the Active threshold, recording 5.75e7 integrated pfu at 14/0001UTC on a declining trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity will most likely be Low, but with a daily Chance of isolated M-class flares.

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Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Current fast winds from CH14/-, are expected to continue to gradually increase through day 1 (14 February), perhaps reaching Strong speeds. Little change is expected through day 2 and 3 (15th and 16th) with possibly a gradual decline through day 4 (17th) to become Slightly Elevated to Elevated again.

Predominantly Unsettled to Active (Kp 3-4) geomagnetic conditions are expected, with isolated G1/Minor geomagnetic storm (Kp 5) intervals likely, especially during day 1 UTC night time period. Day 4 (17th) geomagnetic conditions may decrease to become Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: Overall the high energy proton flux is forecast to persist at Background levels. However, with AR3992 rotating further across the western hemisphere this gives a marginally increased Slight Chance of a S1 event.

The high energy electron flux is expected to remain at Moderate to High levels throughout the forecast period, with the associated fluence remaining below the Active threshold (1e8 integrated flux) but most likely with an increasing trend.

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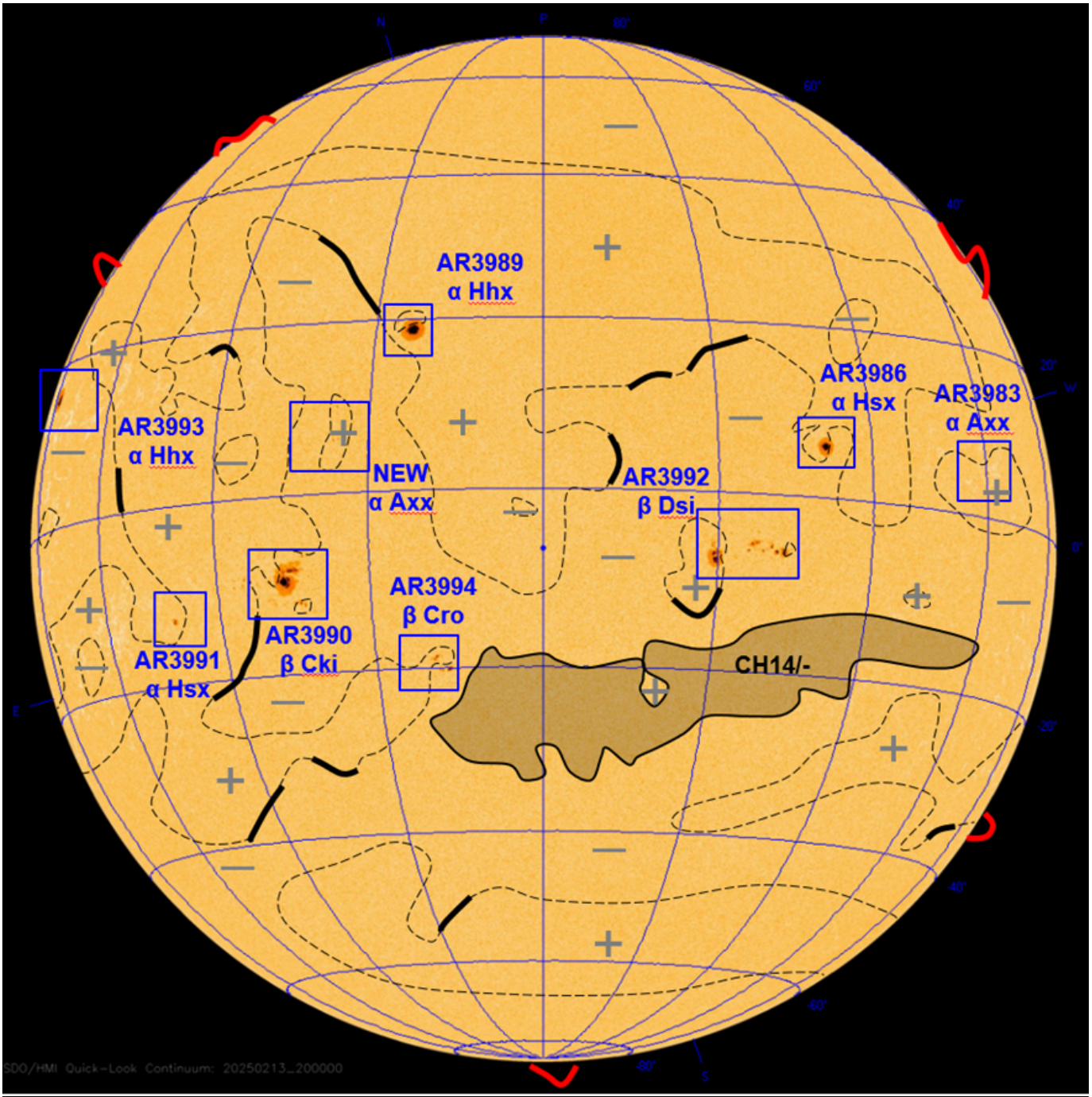
Figure 1: Synoptic map valid 13/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs at time of issue, despite a long duration C-class flare occurring late in the 13th from AR3990. Therefore geomagnetic activity within the forecast period will be as a response to the current high speed stream from CH14/-, the large and pronounced coronal hole in the southern hemisphere. This feature is expected to dominate the entire forecast period, although confidence is slightly lower than previously regarding this due to the recent emergence of a small sunspot region within the CH. This region may briefly interrupt the associated HSS during days 3 to 4 (16th and 17th).

Current fast winds from CH14/-, are expected to continue to gradually increase through day 1 (14 February), perhaps reaching Strong speeds. Little change is expected through day 2 and 3 (15th and 16th) with possibly a gradual decline through day 4 (17th) to become Slightly Elevated to Elevated again.

Predominantly Unsettled to Active (Kp 3-4) geomagnetic conditions are expected, with isolated G1/Minor geomagnetic storm (Kp 5) intervals likely, especially during day 1 UTC night time period. Day 4 (17th) geomagnetic conditions may decrease to become Quiet to Unsettled (Kp 2-3).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	50	40	10	5
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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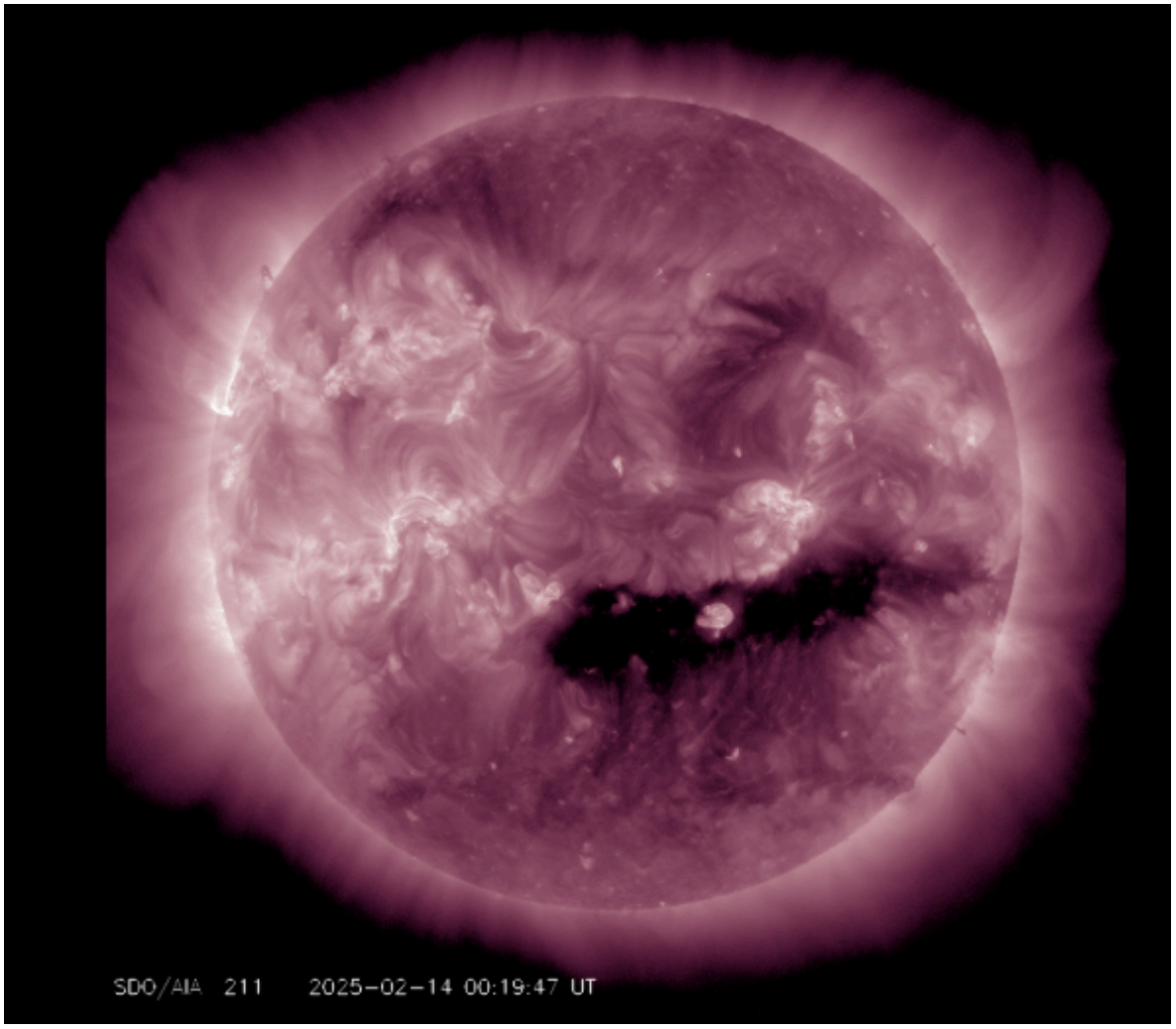
Figure 2: SDO/AIA 211 image showing large coronal hole CH14/- in the southern hemisphere.



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Radio Blackouts - X-Ray Flares

Moderate solar activity was observed in the last 24 hours, with an M1.0 observed at 13/1109UTC from AR3992. Only slightly lower was a C9.0 flare at 13/2243 UTC from AR3990 in the southeast.

There are currently ten sunspots on the current visible disc, of which eight are numbered. There are two unnumbered regions, both small and magnetically simple, although one region is emerging within CH14. The main groups on the current disc are AR3990 and AR3992, the latter over the past 24 hours initially had a strong growth trend but more recently has stabilised and is now classified as Dsi/beta-gamma. AR3990 in the southeastern quadrant has recently shown a slight increase in small spots surrounding the main spot, with its asymmetric penumbra. Some of these small spots have recently developed slight rudimentary penumbra. AR3994 is also a region of note, despite being so small, due to its rapid growth and is currently classified as Dro/beta. The remaining regions on the visible disc remain either small and weak, or larger and stable, although the newly emerging region within the coronal hole is developing.

There is a Chance of further isolated M-class flares, mainly from either AR3990 and AR3992.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	50	50	50
Very Active	R3-R5 (X Class)	No	1	1	1	1

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Solar Radiation Storms (High Energy Protons)

GOES18 proton flux is most likely to persist at background, but with a daily Slight Chance of enhancement from any notable flares from AR3992 as it rotates further across the western hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

Due to the longitudinal extent of CH14 the associated HSS is expected to persist through the forecast period. As the high energy flux has not recently been unduly influenced by diurnal fluctuations and recent Active geomagnetic activity it seems likely that current Moderate to High flux levels will persist, or become predominantly High as the HSS continues and the chance of significant geomagnetic activity gradually declines. Therefore the associated fluence is expected to see a gradual increase, whilst remaining below the Active threshold (1e8 integrated flux). This is the opposite trend compared to the Met Office REFM model, which is showing a decline in fluence levels, and more in keeping with the fluence trend of the past rotation.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	30	40	50	60
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	5

Figure 3: Past 24 hours GOES 16 high energy electron flux.

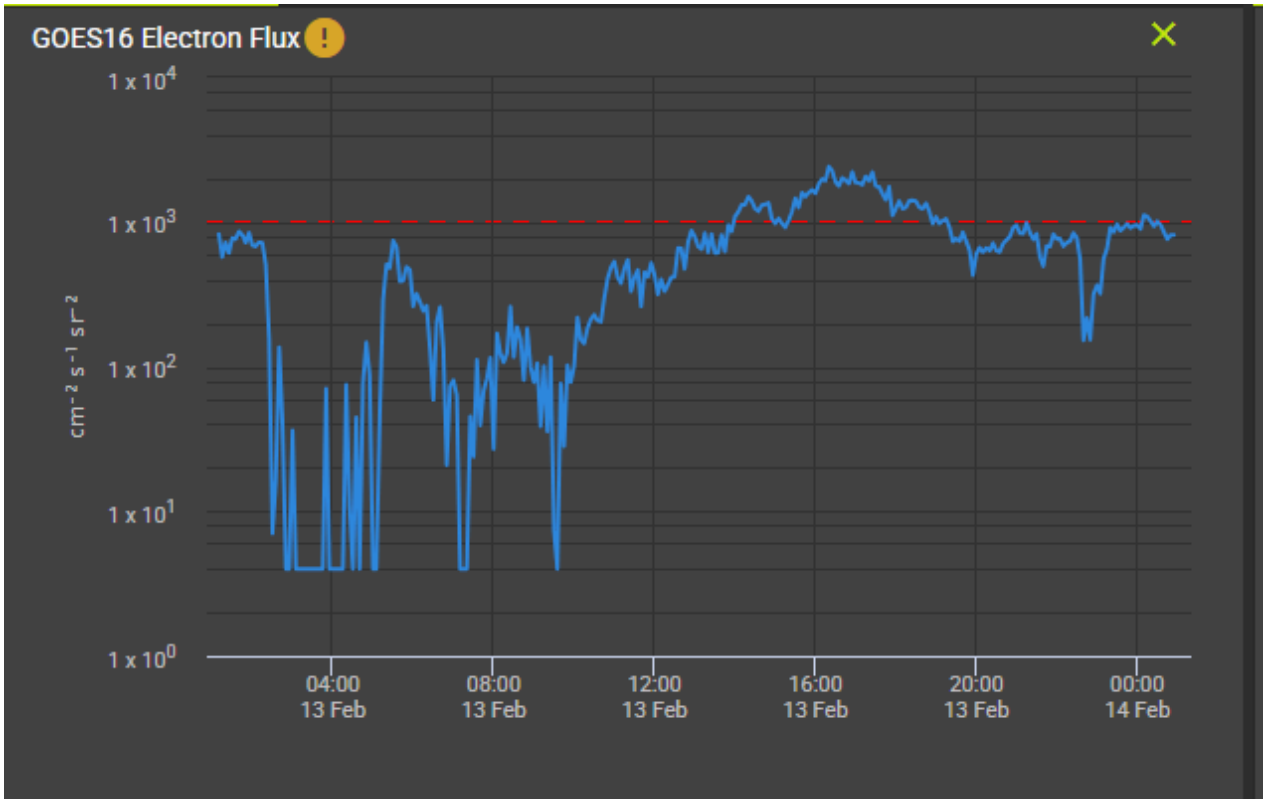

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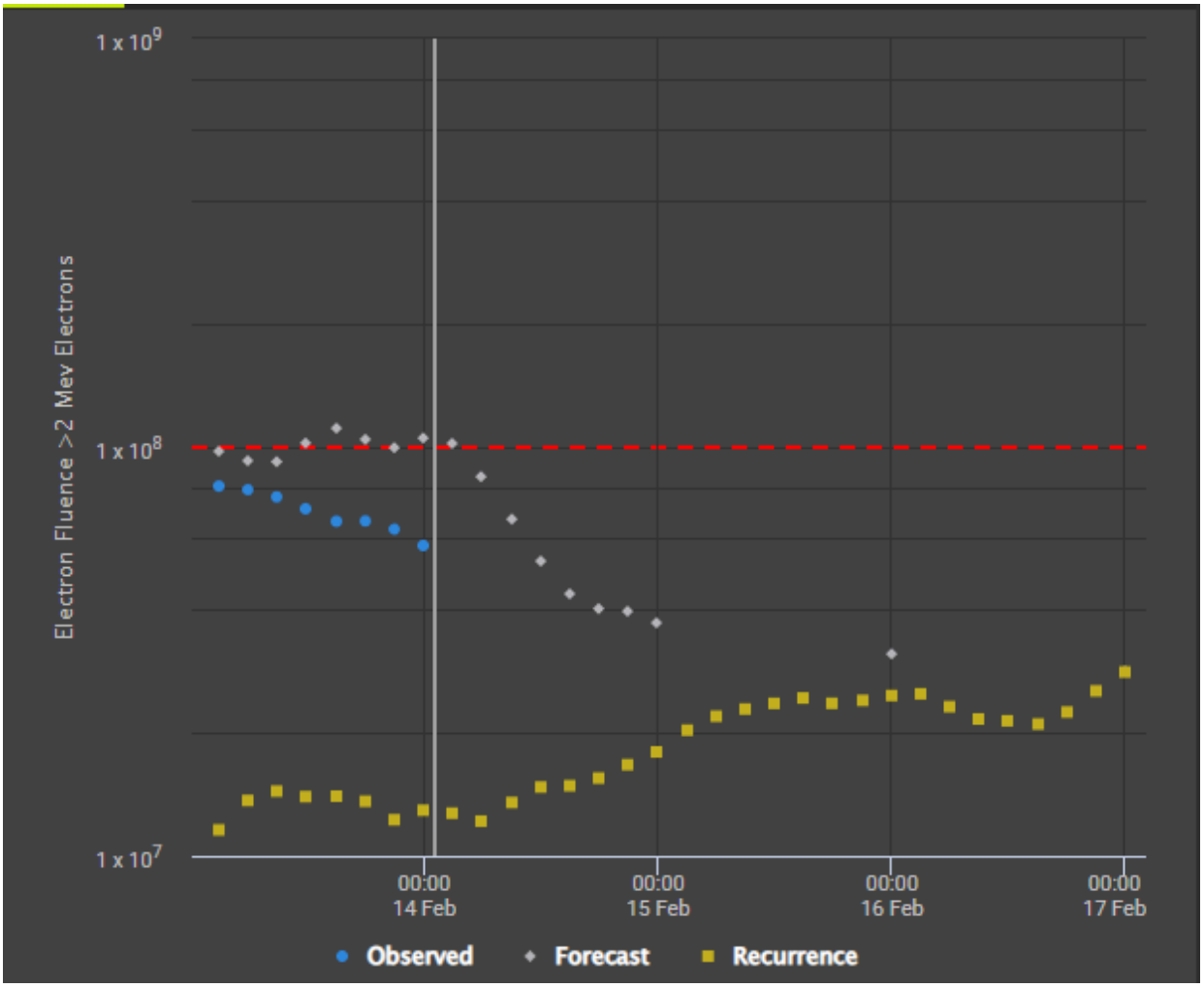
Figure 4: Latest MOSWOC REFM model.



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